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## **7. Photovoltaic, Battery Storage and Solar Ready Buildings**

### **7.1 Overview**

§110.10

Chapter 7 describes the compliance requirements for photovoltaic (PV) systems, battery storage systems, and solar ready for newly constructed residential dwellings, including single-family, and low-rise (three or fewer habitable floors) multifamily buildings. The PV requirement is a new prescriptive requirement for newly constructed single-family and low-rise multifamily buildings. The prescriptive PV requirement also sets the standard design budget for the performance compliance method. Battery storage system is a new compliance option for 2019 and this chapter describes the qualification requirement for this credit. This chapter of the residential compliance manual addresses the “Solar Ready” buildings requirements in §110.10 of the 2019 *Building Energy Efficiency Standards (Energy Standards)*. The requirements for solar ready buildings are mandatory measures for many newly constructed single-family homes and new low-rise multifamily residential buildings that do not have a photovoltaic system due to an exception in Section 150.1(c)14. But due to a change in the 2019 Energy Standards, solar ready is no longer mandatory for newly constructed single-family and low-rise multifamily buildings with installed photovoltaic (PV) systems. As before, solar ready does not apply to additions or alterations of single-family or low-rise multifamily residential buildings. See 7.2 “Covered Occupancies” for more information. The solar ready requirement is implemented when designing the building’s rooftop and associated equipment. The intent is to reserve a penetration-free and shade-free portion of the roof for the potential future installation of a solar energy system. There are no requirements to install panels, conduit, piping, or mounting hardware.

## **7.2 Prescriptive Requirements for Photovoltaic System**

### **7.2.1 Photovoltaic System Size**

§150.1(c)14

To comply with the prescriptive requirements, all low-rise single family and multifamily buildings are required to have a PV system installed unless the building qualifies for an exception. The size of the PV system is based on the projected annual electrical usage as described by the Equation 7-1 below.

Submit a CF1R-SRA-XX-E to the building department with the building permit application for all projects, even when using a PV exception.

Equation 7-1

$$\text{kW PV required} = (\text{CFA} \times \text{A}) / 1000 + (\text{ND}_{\text{well}} \times \text{B})$$

WHERE:

kWPV = kWdc size of the PV system

CFA = Conditioned floor area

ND<sub>well</sub> = Number of dwelling units

A = Adjustment factor from Table 7-1

B = Dwelling adjustment factor from Table 7.1

*Table 7-1 – CFA and Dwelling Adjustment Factors*

<u>Climate Zone</u>	<u>A - CFA</u>	<u>B - Dwelling Units</u>
<u>1</u>	<u>0.793</u>	<u>1.27</u>
<u>2</u>	<u>0.621</u>	<u>1.22</u>
<u>3</u>	<u>0.628</u>	<u>1.12</u>
<u>4</u>	<u>0.586</u>	<u>1.21</u>
<u>5</u>	<u>0.585</u>	<u>1.06</u>
<u>6</u>	<u>0.594</u>	<u>1.23</u>
<u>7</u>	<u>0.572</u>	<u>1.15</u>
<u>8</u>	<u>0.586</u>	<u>1.37</u>
<u>9</u>	<u>0.613</u>	<u>1.36</u>
<u>10</u>	<u>0.627</u>	<u>1.41</u>
<u>11</u>	<u>0.836</u>	<u>1.44</u>
<u>12</u>	<u>0.613</u>	<u>1.40</u>
<u>13</u>	<u>0.894</u>	<u>1.51</u>
<u>14</u>	<u>0.741</u>	<u>1.26</u>
<u>15</u>	<u>1.56</u>	<u>1.47</u>
<u>16</u>	<u>0.59</u>	<u>1.22</u>

### **7.2.2 Exceptions to PV requirements**

There are six allowable exceptions to the prescriptive PV requirements as listed below.

**Exception 1** may apply if there is limited unshaded roof space. No PV is required if the effective annual solar access is restricted to less than 80 contiguous square feet by shading from existing permanent natural or manmade barriers external to the dwelling, including but not limited to trees, hills, and adjacent structures. The effective annual solar access shall be 70 percent or greater of the output of an unshaded PV array on an annual basis.

**Exception 2** may apply to climate zone 15 and the required PV size can be reduced. The PV size shall be the smaller of a size that can be accommodated by the effective annual solar access or a PV size required by the equation above, but no less than 1.5 Watt DC per square foot of conditioned floor area.

**Exception 3** may apply to two stories residential buildings and the required PV size can be reduced. shall be the smaller of a size that can be accommodated by the effective annual solar access or a PV size required by the Equation 150.1-C, but no less than 1.0 Watt DC per square foot of conditioned floor area

**Exception 4** In all climate zones, for low-rise residential dwellings with three habitable stories and single family dwellings with three or more habitable stories, the PV size shall be the smaller of a size that can be accommodated by the effective annual solar access or a PV size required by the Equation 150.1-C, but no less than 0.8 Watt DC per square foot of conditioned floor area.

**Exception 5** For a dwelling unit plan that is approved by the planning department prior to January 1, 2020 with available solar ready zone between 80 and 200 square feet, the PV size is limited to the lesser of the size that can be accommodated by the effective annual solar access or a size that is required by the Equation 150.1-C.

**Exception 6** may apply to buildings with battery storage system. The required PV sizes from Equation 7-1 may be reduced by 25 percent if a battery storage system is installed. For single family building, the minimum capacity of the battery storage system must be at least 7.5 kWh. For multifamily buildings, the battery storage system must have a minimum total capacity equivalent to 7.5 kWh per dwelling. In all case the battery storage needs to meet the qualification requirements specified in Joint Appendix JA12 and be listed with CEC.

### **7.2.3 Additional Requirements**

The installed PV system must meet the applicable requirements as specified in JA11.

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## **7.3 Performance Approach Compliance for Photovoltaic System**

### **7.3.1 Energy Budget Calculation**

The computer performance approach allows for the modeling of the PV system performance by taking into account PV system size, climate, panel orientations, inverter efficiency, and shading characteristics. The standard design PV system size is determined by the modeled annual electrical consumption of the mixed-fuel proposed design building, regardless of the actual fuel type of the proposed design building. The performance method allows for modeling alternative PV size, battery storage system and demand response combinations.

### **7.3.2 Exceptions to PV requirements**

The six allowable exceptions to the prescriptive PV requirements listed in 7.2.2. can also be used under the performance approach. User must select the appropriate exception in the software and provide documentation to the building department with the building permit application.

### **7.3.3 Additional Requirements**

The installed PV system must meet the applicable requirements as specified in JA11.

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## **7.4 Community Shared Electric Generation System**

### **7.4.1 Photovoltaic System Size**

§150.1(c)14

The 2019 Building Energy Efficiency Standards allow the possibility for the Standards requirements for photovoltaics on the site of the residential building to be fully or partially offset by Community Shared Solar Electric Generation. Community Shared Solar Electric Generation means solar electric generation or other renewable technology electric generation that is installed at a different site. Also, the batteries that can be installed in combination with photovoltaics on the building site to gain performance standards compliance credit can be fully or partially offset by Community Shared Battery Storage Systems that are installed at a different site. Community Shared Solar Electric Generation Systems and Community Shared Battery Storage Systems

could be installed in combination or separately. Such systems are hereinafter referred to just as Community Shared Solar Generation Systems.

For these offsets to become available, entities who wish to serve as administrators of a proposed Community Shared Solar Electric Generation System must apply to the Energy Commission for approval, demonstrating that several criteria specified in Section 10-115 of the Standards are met, to ensure that the Community Shared Solar Generation System provides equivalent benefits to the residential building expected to occur if photovoltaics or batteries had been installed on the building site. The Energy Commission will carefully consider these applications to determine if they meet these criteria. If approved, Energy Commission approved compliance software will be modified to enable users to take compliance credit for buildings served by that Energy Commission approved Community Shared Solar Electric Generation System.

Any entity may apply to serve as administrator of a proposed Community Shared Solar Electric Generation System, including but not limited to utilities, builders, solar companies or local governments. The entity will be responsible for ensuring that the criteria for approval are met throughout (at least) a twenty-year period for each building that uses shares of the Community Shared Solar Electric Generation System for partial or full offset of the onsite solar electric generation and batteries, which would otherwise be required for the building to comply with the Standards. Throughout that period the administrator will be accountable to builders, building owners, enforcement agencies, the Energy Commission, and other parties who relied on these systems for offset of full or partial compliance with the Standards. Records demonstrating compliance with the criteria must be maintained over that period, with access to those records provided to any entity approved by the Energy Commission.

Entities interested in applying to serve as administrator of a proposed Community Shared Solar Electric Generation System should become thoroughly familiar with the criteria for approval specified in Section 10-115, and contact the Energy Commission Building Standards Office for further discussion and explanation of the criteria as necessary.

In general, the Community Shared Solar Electric Generation System must meet the following:

#### **A. Enforcement Agency**

The Community Shared Solar Electric Generation System must exist and be available for enforcement agency review early in the permitting process, and shall not cause delay in the enforcement agency review and approval of the building that will be served by the Community Shared Solar Generation System. All documentation required to demonstrate compliance for the building and the compliance offset from the Community Shared Solar Electric Generation System shall be completed and submitted to the enforcement agency with the permit application. The enforcement agency must be provided facilitated access to the Community Shared Solar Electric Generation System to verify the validity and accuracy of compliance documentation.

#### **B. Energy Performance**

Energy Commission approved compliance software must be used to show that the energy performance of the building's share of the Community Shared Solar Electric Generation System is

equal to or greater than the partial or full offset claimed for the solar electric generation and batteries, which would otherwise be required for the building to comply with the Standards.

### **C. Dedicated Building Energy Savings Benefits**

A specific share of the Community Shared Solar Electric Generation System, determined to comply with the Energy Performance requirement above, must be dedicated on an ongoing basis to the building. The energy savings benefits dedicated to the building shall be provided in one of the following ways:

- Actual reductions in the energy consumption of the building;
- Utility energy reduction credits that will result in virtual reductions in the building's energy consumption that is subject to energy bill payments; or
- Payments to the building that will have an equivalent effect as energy bill reductions that would result from one of the other two options above.

The reduction in energy bills resulting from the share of the Community Shared Solar Electric Generation System dedicated to the building shall be greater than the cost that is charged to the building to obtain that share of the Community Shared Solar Electric Generation System.

### **D. Durability**

The benefits from the specific share of the Community Shared Solar Electric Generation System must be provided to each dedicated building for a period not less than 20 years.

### **E. Additionality**

The specific share of the Community Shared Solar Electric Generation System must provide the benefits to the dedicated building that are in no way made available or attributed to any other building or purpose. Renewable Energy Credits that are unbundled from the Community Shared Solar Electric Generation System do not meet this additionality requirement.

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## **7.5 Battery Storage System**

The primary function of the battery storage system is to maximize the benefit of the onsite PV system. The battery storage system accomplishes this by charging the battery when there is limited electrical load at the building and discharging when the electricity is needed. This minimizes electricity export to the grid and maximized solar self-utilization.

Battery storage system is available as a compliance credit in the performance compliance method or to qualify for Exception 6 to the prescriptive PV requirements in section 150.1. In all cases, the battery storage system must meet all applicable requirements in Joint Appendix JA12 and be certified to CEC as a qualified product.

The list of qualified JA12 product list can be found here:

[http://www.energy.ca.gov/title24/equipment\\_cert/](http://www.energy.ca.gov/title24/equipment_cert/)

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## 7.27.6 Solar Ready Overview

The solar ready provisions are mandatory for low-rise residential buildings that do not have a PV system due to an exception in Section 150.1(c)14; “trade-offs” are not allowed. There are exceptions to the “solar zone” requirements, and these are described in the corresponding sections of this chapter. Because solar ready is mandatory, CF1R-SRA-01-E compliance forms must be submitted with the building permit application, even when using an allowable solar zone exception.

Please note: In §110.10 of the *Energy Standards*, the solar zone, interconnection pathways, and design load requirements for low-rise multifamily buildings are located with the high-rise multifamily requirements in §110.10(b)1B. Because most of the low-rise multifamily requirements are identical to high-rise (including three Exceptions), Chapter 9 of the “Nonresidential Compliance Manual” is an additional resource for technical assistance.

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## 7.37.7 Covered Occupancies

### §110.10(a)

The low-rise residential solar-ready requirements apply to most new single-family homes and low-rise multifamily buildings, as described in A and B below. New in the 2019 Energy Standards, the Solar Ready requirement does not apply to low-rise single-family and multifamily with an installed PV system. This is because the 2019 Prescriptive compliance method requires an installed PV system, and the Performance method’s Energy Design Rating incorporates installed PV.

### A. Single-Family Residential Buildings

The solar-ready requirements apply to the following newly constructed single-family homes:

- located in a subdivision with 10 or more residences and
- the Tentative Subdivision Map is complete and approved by the enforcement agency.

If a PV system is installed, these buildings are *excluded* from the solar ready requirement.

Therefore, Solar Ready is not a mandatory measure and there is no need to submit the CF1R-SRA compliance documents.

### B. Low-rise Multifamily Residential Buildings

The solar ready requirements apply to low-rise multifamily buildings having three habitable stories or fewer. If a PV system is installed, these buildings are *excluded* from the solar ready requirement. Therefore, Solar Ready is not a mandatory measure and there is no need to submit the CF1R-SRA compliance documents.

A note about Mixed Occupancy Buildings: The Energy Standards apply to mixed occupancy buildings. Low-rise buildings with nonresidential space on the ground floor and multi-family residential floors above are common examples. The Solar Zone requirements include mixed occupancy buildings.

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## 7.47.8 Solar Zone

### §110.10(b)

The solar zone is a suitable place where solar panels can be installed at a future date - if the owner chooses to do so. A solar zone area is designed with no penetrations, obstructions or significant shade. The solar zone must comply with the access, pathway, smoke ventilation, and spacing requirements in Title 24 Part 9. Requirements from the other parts of Title 24, and those adopted by a local jurisdiction should also be incorporated in the solar zone design.

For single-family homes, the solar zone must be located on its roof or overhang.

For low-rise multifamily buildings, the solar zone can be located on any of the following locations:

1. Roof of the building.
2. Overhang of the building.
3. Roof or overhang of another structure located within 250 feet of the primary building.
4. Covered parking installed with the building project.

See Figure 7-1 for some acceptable solar zone placement techniques.

### 7.3.1 Solar Zone Minimum Area

#### §110.10(b)1

The total area of the solar zone may be composed of multiple subareas - if they meet minimum size specifications. No dimension of a subarea can be less than five feet. If the total roof area is equal to or less than 10,000 square feet, each subarea must be at least 80 square feet. If the total roof area is greater than 10,000 square feet, each subarea must be at least 160 square feet. See Figure 7 -1 for

#### A. Solar Zone Area for Single-Family Residential Buildings

The solar zone must be located on the roof or overhang of the building. The “designated” solar zone’s total area must be no less than 250 square feet (§110.10(b)1A).

There are six allowable exceptions to the required solar zone area. Exceptions 1 and 6 allow alternate efficiency measures instead of an actual solar zone, so the requirements for zone shading, azimuth and design load; interconnection pathway, owner documentation, and electric service panel do not apply either.

Submit a CF1R-SRA-01-E to the building department with the building permit application for all projects covered by solar ready, even when using a Solar Zone Exception. In addition, submit a CF1R-SRA-02-E solar zone worksheet for all projects with a solar zone, including Exceptions that allow a reduced solar zone area.

#### **Solar Zone Exceptions for Single-family Buildings:**

**Exception 1** may apply when a domestic solar water-heating (SWH) system is permanently installed at the time of construction. The SWH system must comply with the installation criteria in the Reference Residential Appendix RA4, and have a minimum solar savings fraction of 0.50. Note: These buildings are also exempt from the interconnection pathway, documentation and electrical panel requirements because there is no solar zone.

**Exception 2** may apply if the single-family home has three or more habitable stories and a total floor area  $\leq 2,000$  square feet. The designated solar zone may be reduced. The area must be  $\geq 150$  square feet.

**Exception 3** may apply if the single-family home is in the Wildland-Urban Interface Fire Area (as defined in Title 24, Part 2). The solar zone area may be reduced to  $\geq 150$  square feet. In addition, a whole-house fan must be permanently installed at the time of construction. This exception is intended to accommodate attic- and roof-venting requirements in these fire areas.

***New in the 2019 Energy Standards: this exception may be used in all Climate Zones.***

**Exception 4** reduces the solar zone area when the roof is shaded by objects that are

not part of the building project, and therefore beyond the designer's control. The designated solar zone may be reduced to  $\geq 50$  percent of the potential solar zone area when solar access is limited as described below. When the "potential" solar zone is smaller than the 250 square feet minimum, the solar zone can be reduced to half the area of the potential solar zone. The reduced-size solar zone is called the "designated" solar zone.

**Figure 7-2: Exceptions for Reduced Solar Zone Due to Shade**

**Step 1:** Determine the Annual Solar Access: For the solar ready requirements, solar access is the ratio of solar insolation including shading to the solar insolation without shading. Annual solar access is most easily determined using specialized software.

$$\text{Solar Access} = \frac{\text{Solar Insolation Including Shading}}{\text{Solar Insolation Without Shading}}$$

Solar access does not take into account shading from objects that are included in the building project because the designer has control of potential obstructions. Objects that are not part of the building project cannot be moved or modified as part of the project and include existing buildings, telephone poles, communication towers, trees, or other objects. Objects that are considered part of the building project are objects constructed as part of the building project and include the building itself, its HVAC equipment, outdoor lights, landscape features and other similar objects.

First evaluate whether there are any objects outside the building project that will shade the rooftop (or other prospective solar zone areas such as overhangs or parking shade structures). If an existing object is located north of all potential solar zones, the object will not shade the solar zone. Similarly, if the horizontal distance ("D") from the object to the solar zone is at least two times the height difference ("H") between the highest point of the object and the horizontal projection of the nearest point of the solar zone, then the object will not shade the solar zone (See Figure 7-4).

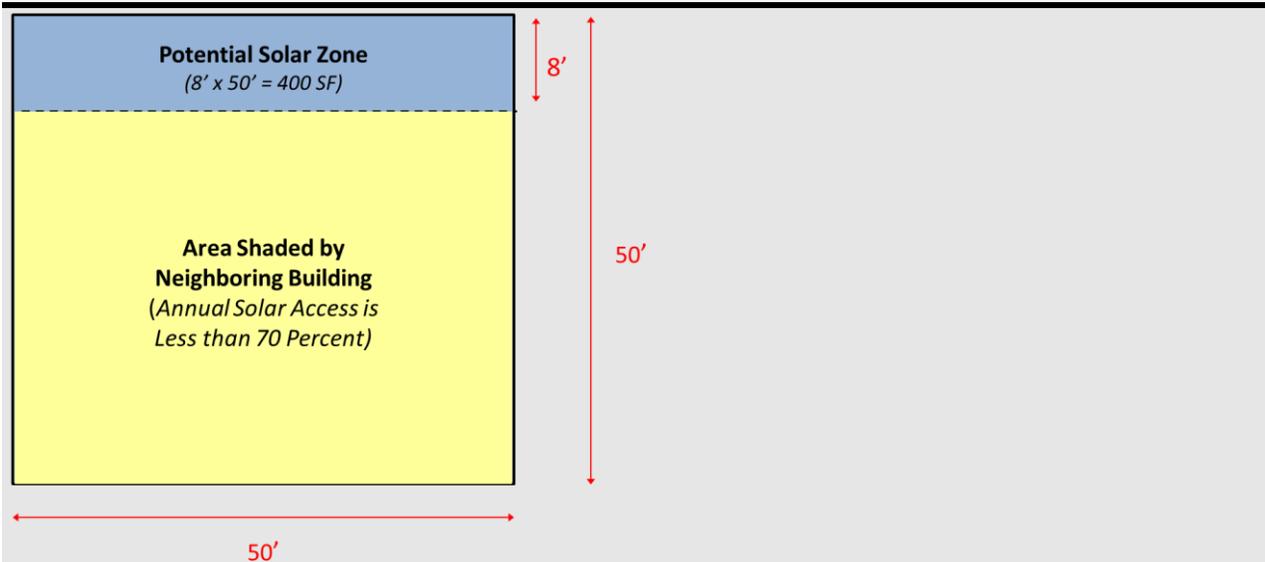
**Step 2:** Determine the Potential Solar Zone Area: On low-sloped roofs, the potential solar zone is the area where annual solar access is  $\geq 70$  percent.

On steep-sloped roofs the potential solar zone is the area where the annual solar access is  $\geq 70$  percent on the portion oriented between 90 and 300 degrees of true north.

**Step 3:** Determine the size of the designated solar zone. The designated solar zone must be  $\geq 50$  percent of the potential solar zone area. If the roof is shaded such that there is no potential solar zone area, then no solar zone is required. See Figure 7.1.

**Example 7-2**

A house has a total roof area of 2,500 SF. The neighbor's house and trees shade the roof, so 2,100 SF of the roof has less than 70 percent annual solar access. How big does the solar zone have to be?

**Answer**

If the entire roof were to have an annual solar access of 70 percent or greater, the minimum solar zone would have been 250 SF. Since the potential solar zone is only  $2,500 - 2,100 = 400$  SF, however, the minimum solar zone can be reduced to 50 percent of the potential solar zone, or 200 SF.

**Exception 5** allows a reduced solar zone of  $\geq 150$  square feet if all thermostats have demand responsive controls that comply with §110.12(a)\*. See Appendix H of this compliance manual for guidance on compliance with the demand responsive control requirements. In addition, the technical specifications for compliant demand responsive control thermostats are detailed in Joint Appendix JA5.

\*§110.12 is a new section in the 2019 Energy Standards that specifies capabilities for demand responsive controls. A “demand responsive control” is defined in §100.1 as an “automatic control capable of receiving and automatically responding to a demand response signal.”

**Note:** The thermostats must be installed in the residence before the local enforcement agency grants the occupancy permit.

**Exception 6** allows no solar zone when the following energy efficiency features are installed:

All thermostats have demand responsive controls that comply with Section 110.12(a) and Joint Appendix JA5. (Please see Exception 5, above, for more details). AND

**One of the following four measures (i – iv):**

- i. Install a dishwasher that meets or exceeds the ENERGY STAR® program requirements with
  - a refrigerator that meets or exceeds the ENERGY STAR program requirements, OR
  - a whole-house fan driven by an electronically commutated motor, OR
  - an SAE J1772 Level 2 Electric Vehicle Supply Equipment (EVSE or EV Charger) with a minimum of 40 amperes. SAE J1772 is the SAE International document titled “SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler” (SAE J1772\_201710).

- ii. Install a home automation system that is capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand response signals; OR
- iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the *California Plumbing Code*; OR
- iv. Install a rainwater catchment system designed to comply with the *California Plumbing Code* and uses rainwater flowing from at least 65% of the available roof area.

### **B. Solar Zone Area for Low-Rise Multifamily Residential Buildings**

The solar zone requirement for low-rise multifamily buildings is located in the 2019 Energy Standards with the requirements for high-rise multifamily, hotel/motel and nonresidential buildings in §110.10(b)1-B. The solar zone requirement for low-rise multifamily buildings applies to mixed occupancy buildings as well.

The solar zone must be located on the roof or overhang of the building, or on the roof or overhang of another structure located within 250 feet of the building, or on covered parking installed with the building project. The solar zone's total area must be  $\geq 15$  percent of the building's total roof area. Subtract any skylight area when calculating the roof's total area.

Four solar zone exceptions apply to low-rise multifamily buildings in the 2019 Energy Standards. Exception 3 allows a smaller solar zone under certain circumstances. Exceptions 4 and 5 allow alternate efficiency measures in lieu of a solar zone. Therefore the requirements for solar zone shading, azimuth and design load; interconnection pathway, and documentation do not apply. Exceptions 1 and 2 do not apply to low-rise multifamily buildings.

**Exception 3 reduces the solar zone area when the roof is shaded by objects that are not part of the building project, and therefore beyond the designer's control. The reduced-size solar zone is called the "designated" solar zone. The designated solar zone may be reduced to  $\geq 50$  percent of the potential solar zone area when solar access is limited. Solar access is the ratio of solar insolation including shade to amount of solar insolation without shade. Shading from obstructions on the roof or other parts of the building cannot be included to determine annual solar access.**

See Figure 7-2 for more information about calculating the designated solar zone.

- **Low-sloped roof:** the potential solar zone area is the total area of any roof where annual solar access is 70% or greater.
- **Steep-sloped roof:** The potential solar zone area is the roof area where annual solar access is 70% or greater and oriented between 90 and 300 degrees of true north.

**Exception 4 says multifamily residential buildings do not need a solar zone if all thermostats have demand responsive controls that comply with Section 110.12(a) and Joint Appendix JA5. See Exception 5 for single-family homes (above) for more thermostat details. In addition to the compliant thermostats, choose A or B below:**

#### **A. One of the following four measures installed in each dwelling unit (i. – iv.):**

- i. Install a dishwasher that meets or exceeds the ENERGY STAR® program requirements with a refrigerator that meets or exceeds the ENERGY STAR program requirements, or a whole-house fan driven by an electronically commutated motor.
- ii. Install a home automation system that complies with §110.12(a) and is capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand response signals; or

- iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the *California Plumbing Code*; or
- iv. Install a rainwater catchment system designed to comply with the *California Plumbing Code* and that uses rainwater flowing from at least 65 percent of the available roof area.

B. Meet the Title 24 Part 11, Section A4.106.8.2 requirements for electric vehicle charging spaces.

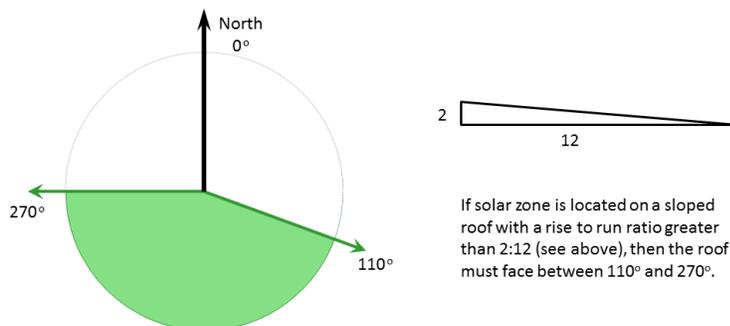
Exception 5 includes low-rise multifamily buildings and says a solar zone is not required when the roof is designed and approved to be used for vehicular traffic, or parking, or a heliport.

### 7.4.27.8.2 Azimuth (Solar Zone)

§110.10(b)2

For both single-family residential and low-rise multifamily buildings, all sections of the solar zone on steep-sloped roofs (ratio of rise to run of greater than 2:12) must be oriented between 90 degrees and 300 degrees of true north. The orientation is important because it ensures a reasonable solar exposure if a solar energy system is installed in the future. On a low-sloped roof (ratio of rise to run of 2:12 or less), the azimuth requirement does not apply.

**Figure 7-3: Orientation when solar zone is located on a steep-sloped roof**



### 7.4.37.8.3 Shading (Solar Zone)

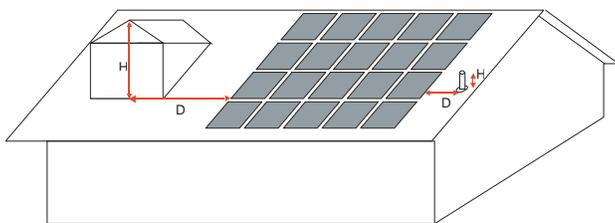
§110.10(b)3

For both single-family residential and low-rise multifamily buildings, the solar zone must be free from roof penetrations and shall not have any obstructions such as vents, chimneys, architectural features, or roof-mounted equipment located in the solar zone. This requirement ensures that the solar zone remains clear and open for the future installation of a solar energy system.

Any obstruction located on the roof or any other part of the building that projects above the solar zone must be located at a sufficient horizontal distance away from the solar zone in order to reduce the resulting shading of the solar zone. For each obstruction, the horizontal distance (“D”) from the obstruction to the solar zone shall be at least two times the height difference (“H”) between the highest point of the obstruction and the horizontal projection of the nearest point of the solar zone.

$$\text{Shading Equation: } D \geq 2 \times H$$

Figure 7-4: Schematic of /



Source: California Energy Commission

Any obstruction oriented north of all points of the solar zone is not subject to the shading requirement. Any obstruction that is not located on the roof or another part of the building, such as landscaping or neighboring building, is not subject to the shading requirement.

### 7.3.4 Structural Design Loads (Solar Zone)

The structural design loads for roof dead load and roof live load must be clearly indicated on the construction documents for the designated solar zone areas. The structural load information will be easily available if the building owner considers a solar energy system installation in the future. It is not necessary to estimate the collateral loads for future solar energy systems.

The structural design loads requirement applies to the solar zone on both single-family residential and low-rise multifamily buildings.

## 7.57.9 Interconnection Pathways

§110.10(c)

All buildings that comply by designating a solar zone must also include a plan for connecting a future PV and SWH system to the building's electrical or plumbing system. The construction documents must indicate:

1. A reserved location for inverters and metering equipment for solar electric systems.
2. A reserved conduit route from the solar zone to the point of interconnection with the electrical service. There is no requirement to install any conduit.
3. For single family residences, and multifamily buildings with a central water heating system, a reserved plumbing pathway from the solar zone to the water-heating system connection. There is no requirement to install any plumbing.

This requirement applies to both single-family residential and low-rise multifamily buildings.

## 7.67.10 Documentation

§110.10(d)

A copy of the construction documents or a document containing the required solar-ready information must be provided to the occupant. The building occupant must also receive a copy of compliance forms CF1R-SRA-01-E and CF1R-SRA-02-E. Providing this information to the

building occupant is required so the information is available if the owner decides to install a solar energy system in the future. Construction documents must include information about the as-designed structural loads, solar zone location, and the reserved interconnection pathways. This requirement applies to both single-family residential and low-rise multifamily buildings.

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## **7.77.11 Main Electrical Service Panel**

§110.10(e)

This requirement applies only to single-family residential buildings. The main electrical service panel must have a minimum Busbar rating of 200 amps. The panel must also include space to install a double-pole circuit breaker in the future, if one is not installed during construction. These items are required to simplify the possible future installation of a solar electric system.

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## **7.8 California Fire Code Solar Access Requirements**

~~Under regulations established by the Office of the State Fire Marshal, the 2016 version of Parts 2, 2.5, and 9 of Title 24 include requirements for the installation of rooftop solar photovoltaic systems. These regulations cover the marking, location of DC conductors, and access and pathways for photovoltaic systems. They apply to residential and nonresidential buildings regulated by Title 24 of the California Building Standards Codes. Provided below is a brief summary of the fire code requirements for residential buildings.~~

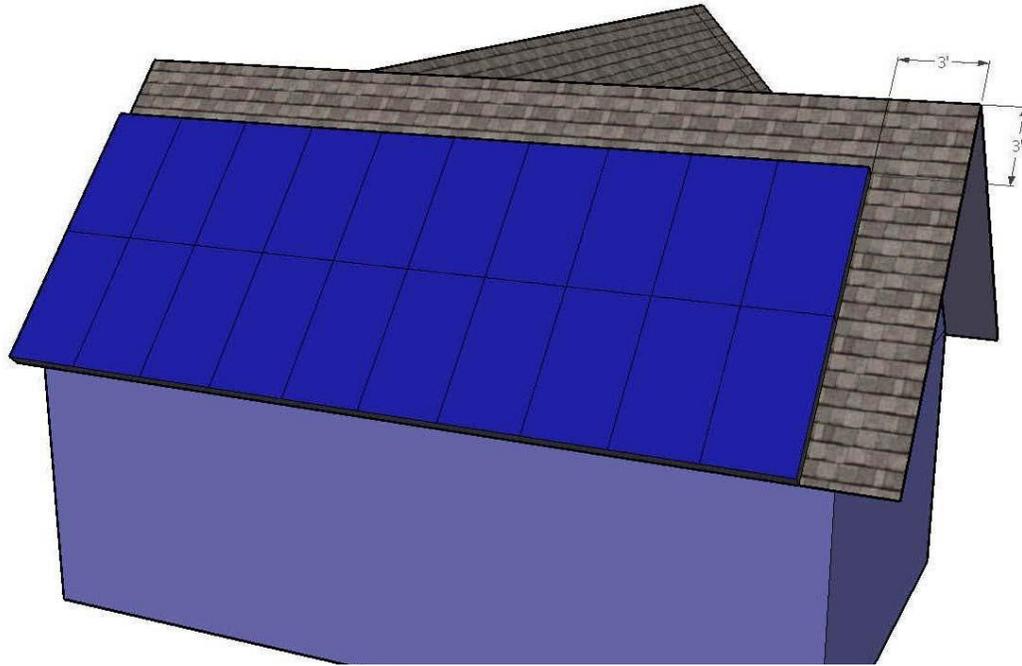
~~PV arrays shall not have dimensions in either axis greater than 150 feet. Residential buildings with hip, ridge/valley roof features shall provide a 3-foot access pathway away from applicable eave to hip/ridge/valley features. To provide adequate smoke ventilation, PV arrays shall not be located higher than 3 feet below the ridge. Builders shall refer directly to the relevant sections of Title 24 (most currently Part 2: Section 3111, Part 2.5 Section R331, and Part 9 Section 903.3) for detailed requirements.~~

~~In addition to the requirements in the fire code, the California Department of Forestry and Fire Protection – Office of the State Fire Marshal (CAL FIRE OSFM), local fire departments (FD), and the solar photovoltaic industry previously developed a *Solar Photovoltaic Installation Guideline* to increase public safety for all structures equipped with solar photovoltaic systems. The intent of this guideline is to provide the solar photovoltaic industry with information that will aid in the designing, building, and installation of solar photovoltaic systems in a manner that should meet the objectives of both the solar photovoltaic industry and the requirements now set forth in the California Fire Code.~~

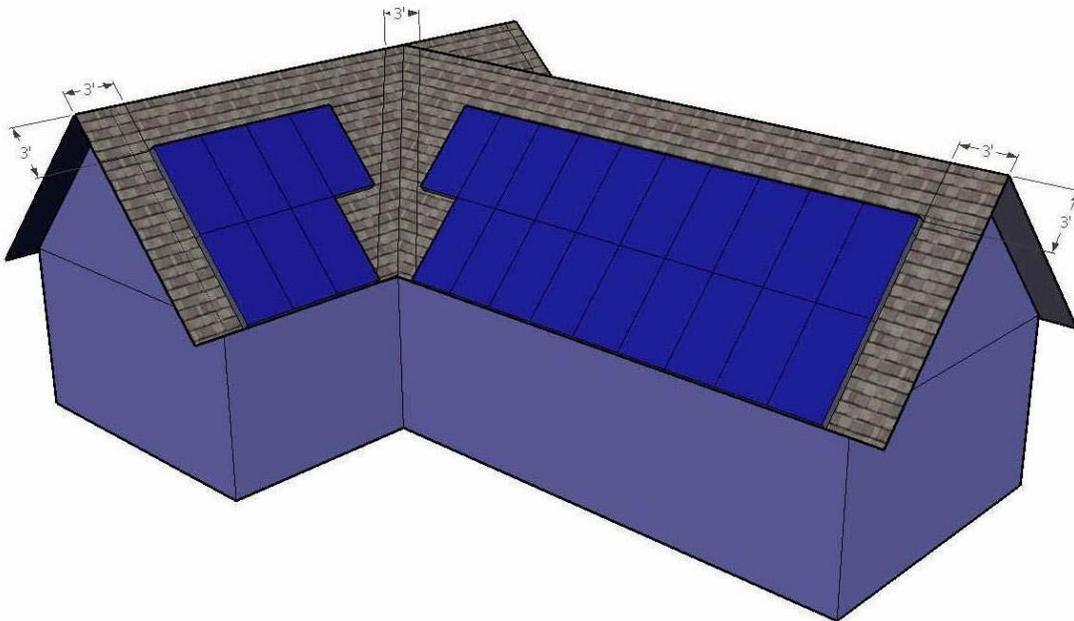
~~The entire Solar Photovoltaic Installation Guideline can be accessed at <http://osfm.fire.ca.gov/pdf/reports/solarphotovoltaicguideline.pdf>~~

**Figure 7-1:** The following illustrations demonstrate some acceptable solar access techniques.

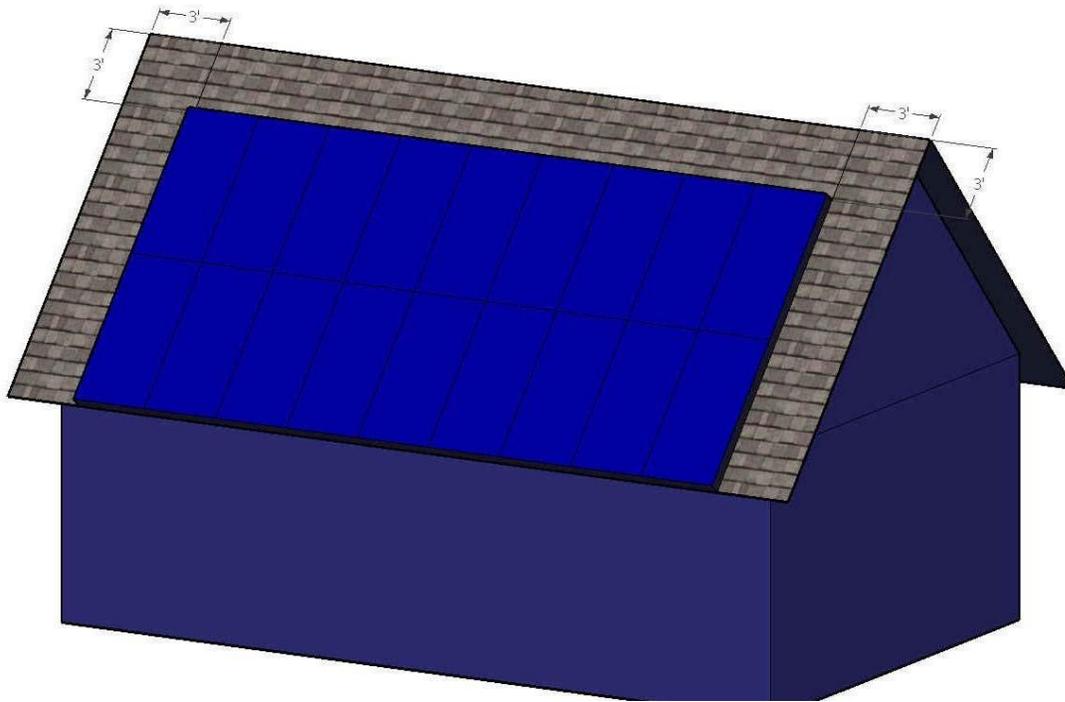
**Cross Gable Roof**



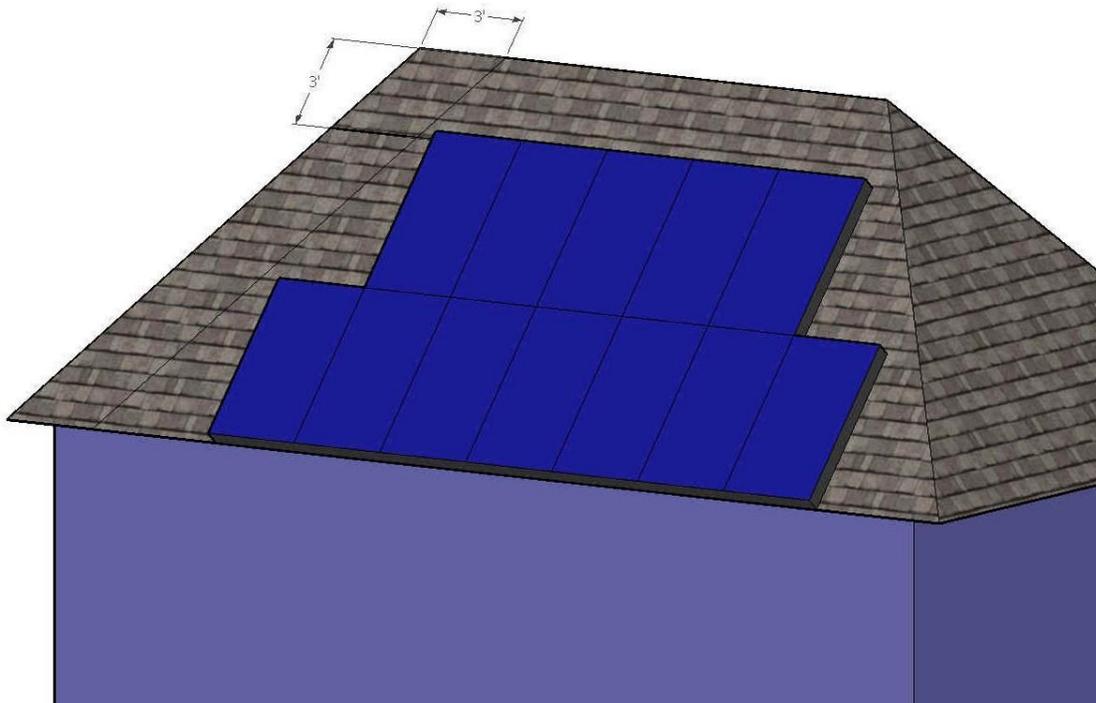
**Cross Gable Roof with Valley**



**Full Gable Roof**



**Full Hip Roof**



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**7.97.12 Compliance and Enforcement**

When a building permit application is submitted to the enforcement agency, the applicant also submits plans and energy compliance documentation. This section describes the forms and procedures for documenting compliance with the solar ready requirements of the Energy Standards. The following discussion is addressed to the designer preparing construction and

compliance documents, and to the enforcement agency plan checkers who are examining those documents for compliance with the Standards.

There are four forms associated with the low-rise residential solar-ready requirements. Each form is briefly described below.

1. CF1R-SRA-01-E: Certificate of Compliance: Residential Solar Ready Areas

This form is required for every project where the solar-ready requirements apply: newly constructed single-family residential and low-rise multifamily buildings.

2. CF1R-SRA-02-E: Certificate of Compliance: Minimum Solar Zone Area Worksheet

This form is required when buildings comply with the solar-ready requirement by including a solar zone. That is, an appropriately sized solar PV system is not installed, an appropriately sized solar water heating system is not installed, the building does not comply with all the OCST and high-efficacy lighting requirements or the roof is not designed for vehicle traffic or a heliport.

3. CF2R-STH-01-E: Certificate of Installation – Solar Water Heating System

Single Family Residential Only: This form is required when the building is using solar zone Exception 1 because a compliant solar water heating system has been installed on the home.